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Image Processing on Morphological Traits of Grape Germplasm

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The methods of image processing of grape plants was developed to make the description of morphological traits more accurate and effective. A plant image was taken with a still video camera and displayed through a digital to analog conversion. A high-quality image was obtained by 500 TV pieces as a horizontal resolution, and in particular, the degree of density of prostrate hairs between mature leaf veins (lower surface). The analog image was stored in an optical disk to preserve semipermanently without loss of quality. However, the analog processed image was shown to be inadequate in retrieval and image analysis, and a revision of the data management system should be required.

INTRODUCTION

Morphological traits of grapes (*Vitis* spp.) are the most important key for classification, identification and registration of their accessions. From the early beginnings of this century, the description of grape species and varieties (Ampelography : from the Greek *amplos* for vine and *graphe* for description) has been established as a science based on their botanical descriptions (Viala and Vermorel, 1901-1910 ; Ravaz, 1902 ; Hedrick, 1908 ; De Lattin, 1939 ; Levadoux et al., 1962 ; Galet, 1956 1964 ; Galet, 1979).

Recently, many of the morphological traits used in ampelography are coded from 0 to 9 which makes notation in viveyards quicker and more efficient (IBPGR, 1983). However, the acquirement of the basic principles of ampelography takes time and needs an appropriate training course. Furthermore, it is difficult to interpret an original plant image by code numbers alone. As a ampelographic measurements have been previously established, to support decision-making, the development of an expert system is needed if an expected person is in charge. Therefore, image data will be a useful tool to make ampelographic work more accurate and effective.

Recent progress in information science has been promoted the processing and analysis of image. In agricultural researches, pattern recognition of plant growth (Eguchi and Matsui, 1977), chromsome image analysis (Fukui, 1988), image database (Ninomiya and Saio, 1986) and evaluation of plant shape (Lebowitz, 1989 ; Ninomiya and Shigemori, 1991) have been reported.

In this study, an image processing of several morphological traits of grapes was conducted by controlling crop cultivation via telecommunication which was developed by Nippon Telegraph and Telephone Corporation, Chugoku Telecommunications Service Region.

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MATERIALS AND METHODS

Plant material

The grape plants used in this study were 7 accessions (*V. riparia*, *V. rupestris*, 'Kyoho', 'Concord', 'Delaware', 'Nehelescol 'and 'Muscut Bailey A '). These accessions were grown at the experimental vineyard of University Farm, Faculty of Agriculture, Kyushu University, Fukuoka, Japan.

System and procedure for image processing

Figure 1 shows a block diagram of image processing system. The system consists of a still video camera (MVC -5000, sony) equipped with a zoomlens (f = 9.5 to 123.5 mm, F 1.8 : MCL-913T, Nikon), a video floppy disk (MP-50,sony), a video recorder (MVR-5600, Sony), a color TV monitor (PVM - 9020, Sony), optical disk recorders (LVR - 5600 and LVS - 5000, sony), a video printer (UP - 5000, sony) and a control computer (PC-9801 RA, NEC). The plants were sampled at ripe stage, and the shape of mature leaf blade (upper surface), the density of prostrate hairs between mature leaf veins (lower surface) and bunch were measured. The plant image was taken by the video camera and processed by the analog red (R), green (G) and blue (B) signals, and these RGB signals were digitized into three digital images. Each of the digital images was composed of 768 x 493 pixels and each pixel had the memory of 8 bits, so that each pixel was expressed by gray scale of 256 ($= 2^8$) steps in each color (256^3 steps in a full color image). These images were stored in a disk memory, and then displayed at a TV monitor passing through a digital to analog converter. A 32 -bit personal computer was used for recording, retrieving and printing out of the image data

RESULTS AND DISCUSSION

In this image processing system, two CCD image sensor were used in the video

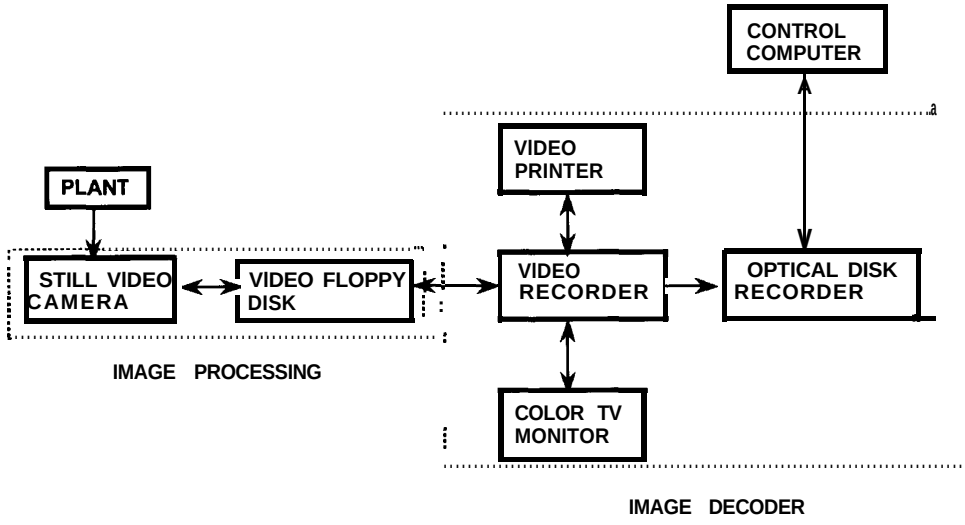

Fig. 1. Block diagram of image processing system used in this study.

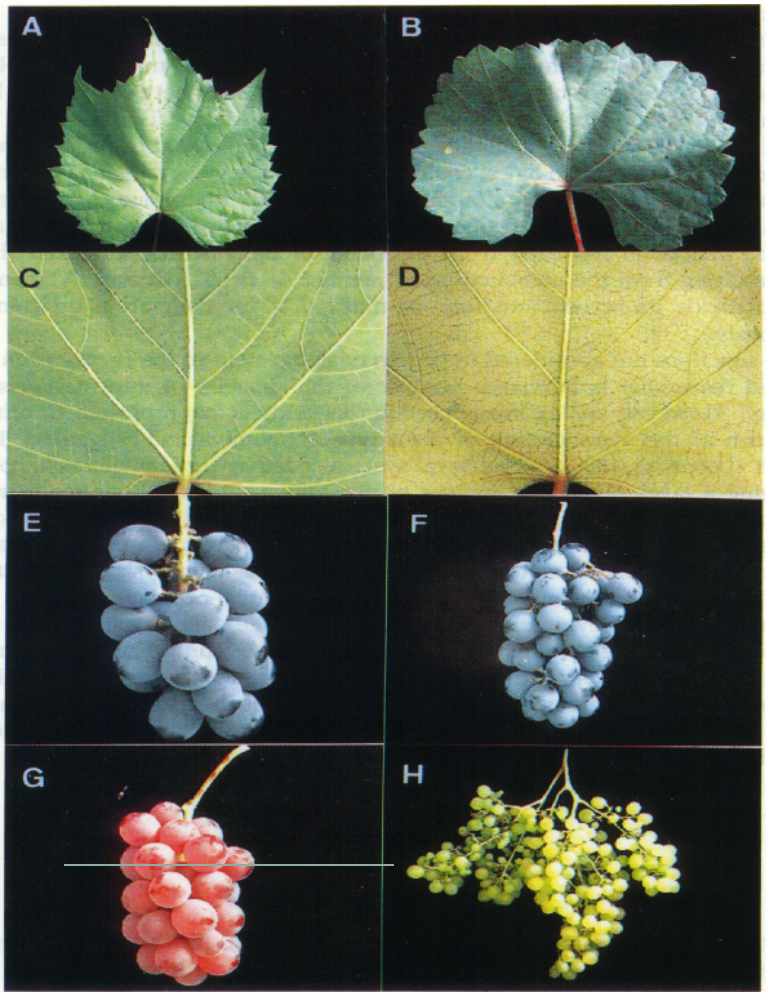

Fig. 2. Typical images of morphological traits in grape plants were as follows: shape of mature leaf blade (A: wedge-shaped, B: kidney-shaped), density of prostrate hairs between mature leaf veins (C: medium, D: very dense) and bunch (E: Kyoho, F: Muscat Bailey A, G: Delaware and H: Nehelescol).

camera. One was for the processing of luminance signal and the other was for that of chrominance signal, so that a high-quality image was obtained by 500 TV pieces as a horizontal resolution. These high-quality images were possible to maintain semipermanently without loss of quality such as a color negative plate during

preservation.

The images of grape plants, as shown in Fig. 2 , were similar to those of the originals, and their typical images were as follows : shape of mature leaf blade (A : wedge-shaped, B : kidney-shaped), density of prostrate hairs between mature leaf veins (C : medium, D : very dense) and bunch (E : 'Kyoho' , F : *Muscat Bailey A', G : 'Delaware 'and H : 'Nehelescol') . The detailed phase of morphological traits, particularly the degree of density of prostrate hairs, could be clearly observed by the analog image.

The processed images were stored in a floppy disk (maximum : 25 frame) or an optical disk (maximum : 10000 frame). Images are generally stored in the latter, and each of the images is retrieved from the point of optical disk allocated three code numbers resulting from the combination of number 0 to 9 . In the TV monitor, it is possible to divide its screen into four or nine parts for comparing different images simultaneously.

These functions are considered to be less misjudgement at the survey even if a less-experienced researcher is in charge because of the capacity of information stock and split display. However, analog image used in this study is inappropriate to other image analyses such as the measurement of plant type (Ninomiya and Shigemori, 1991) and root length (Lebowitz, 1988). A retrieval system coded by three numbers is not suitable for managing a large number of images of accessions since the maximum number of combination of code number is 1000 $(=10^3)$. Furthermore, the optical disk can not replace the already existed image by new-made one. In terms of image database, high-quality image is desirable despite of less capacity for image analysis. The system used, therefore, needs the improvement of stock and the retrieval of image data.

With respect to the evaluation of germplasm, image data is expected to be useful for documentation of the chromatogram of a chemical costitution and the zymogram of a protein or enzyme as well as the morphological traits. Furthermore, the difficulties of germplasm collection increases rapidly because of much interest on germplasm as resources. Little loss of image facsimile used in this system between Japan and Mexico (Takeuchi et el. ,1992), indicating that a facsimile of high -quality images could be possible by the telecommunication using a communication satellite without removing the plants..

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